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INNOVATION AND REGIONAL SOCIO-ECONOMIC DEVELOPMENT – EVIDENCE FROM THE FINNISH LOCAL ADMINISTRATIVE UNITS (1)

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ABSTRACT. It is often argued that innovation plays a key role in the economic growth of regions. Therefore, the impacts of innovation on the socio-economic development of regions have been widely discussed in previous studies, but with divergent areal coverage, methods, and datasets. As a point for departure, these relationships redrawn from international literature are tested here with a single dataset from Finnish local administrative units and with coherent methods. As there does not seem to be a generally accepted indicator for innovation which can claim to be superior, despite the growing literature on the subject, research and development (R&D), and patent statistics are used in this paper to represent innovation activity. The significant, strong, and positive relationship between innovation and traditional socio-economic variables is verified using Finnish regions.

KEY WORDS: Finland, regional socio-economic development, innovation, research and development, patents.

INTRODUCTION

It is often argued that innovations are highly influential for productivity and economic growth (Crosby, 2000; Piekkola, 2006), so the innovativeness of regions is an important, if not the key, factor for economic and regional development (Acs, Varga, 2002; Tang, 2006). Numerous studies (see below) elaborate connections between innovation and regional socio-economic development through the examination of individual variables. The results are encouraging as several of the individual variables (e.g., GDP, income, etc.) that could be used to describe the state of a region's development seem to be collinear with the indicators of innovation. These presumptions drawn from international literature on innovation and socio-economic development are tested in the case of Finnish local administrative units. In short, the aim of this paper is to describe the linkages between innovation and regional socio-economic development in a more comprehensive and systematic way, by using a single dataset and coherent methods, than in previous studies.

Although the research on innovation has boomed in the last few decades, there is still no clear consensus as to the indicators by which innovation should be measured. As the need to use more than one dimension of innovation has long been recognized (e.g., Damanpour, 1991), the most common indicators of innovation, patents and R&D expenditure, are used in this study. Both of these measures are widely used and provide, at the very minimum, a good proxy for innovation, containing useful information on the innovative activities of regions, offering good data availability and reliability (Sterlacchini, 2008; Hasan, Tucci, 2010).

REGIONAL DEVELOPMENT

Regional development is a concept associated with positive attributes and it can be seen as a resource which does not automatically guarantee the well-being of residents, but offers a means to it. According to the classical theory of Myrdal (1969), regional development can be seen as a non-uniform process of cumulative causation, which is carried forward by fundamental innovations and which has the tendency to start in a small group of cores. These cores develop as centres of commerce, employment, and finance. The regions outside these cores fall behind and are in many ways dependent on the cores. Furthermore, regional development is a scale issue. In a global context, Finland is a developed country, but, on the other hand, there are regional differences within Finland. Consequently, regional development is regarded as uneven at its very base (Siirilä et al., 1990). However, the classical theory of regional development alone, described in short above, is an unsatisfactory explanation for economic growth. Thus, new concepts of regional development emphasize the importance of investments in human and technical capital and policies directed towards knowledge generation, innovation, and learning (Szajnowska-Wysocka, 2009).

Traditionally, variables such as industrialization, productivity, and GDP have been used to describe the development stage of a region. Nowadays, more technologically and scientifically oriented factors have replaced conventional variables as key elements of development. Earlier studies (Ebersberger, 2005; Florida et al., 2008) have shown that education, knowledge, R&D, and innovations are becoming more important factors affecting economic growth and regional development. Furthermore, the historically dominant focus on the economic factors of development has broadened to include social, ecological, political, and

cultural elements. The concept of development is largely a covenanted issue and it must be agreed what represents the concept of development (and to what extent). What constitutes development is geographically differentiated and changes over time (Pike et al., 2007). Thus, variables selected to describe the state of regional socio-economic development in this study are the most influential and also most commonly used in previous studies (see below) concerning regional development in Finland. These factors include traditional socio-economic variables such as GDP, unemployment, the percentage of the adult population that has completed higher education, etc. The availability or scarcity of these ‘resources’ defines the stage of development of a region.

In theory at least, Finnish regional and development policy has traditionally been in favour of balancing regional disparities whereby quality of life and employment opportunities, etc., are similar in every part of the country (e.g., Jauhiainen, 2008). However, previous studies on the regional economic development and well-being in Finland have shown that, Southern Finland, especially the Helsinki Metropolitan Region, is more developed when compared with the rest of the country (Rantala, 2001; Mikkonen, 2002; Siirilä et al., 2002). In addition, most university cities, including Tampere, Turku, Oulu, and Jyväskylä (see Fig. 1), act as strong growth centres. Finland is also following a polycentric growth model with regional (and university) cores (Antikainen, Vartiainen, 2005) highlighting the prominent role of innovation activity and knowledge-based development in Finland. The importance of universities in pursuit of economic growth has also been recognized in previous international studies as knowledge flows, university start-up enterprises (spin offs), and the availability of educated workers who constitute a comparative advantage for university regions (c.f. Goldstein, Renault, 2004; Bramwell, Wolfe, 2008). Furthermore, although now suffering from difficulties, the Finnish information and communication technology sector (ICT-sector) has been one of the leading regional growth engines. This has led to a situation where strong R&D oriented regions, such as Salo (largely due to Nokia’s strong presence in the region), have also emerged as regions with high growth potential. In view of the above, it seems plausible to suggest that innovation and socio-economic development are connected in Finland at the regional level.

REGIONAL INNOVATION RESEARCH

In this study the main focus is on technical product innovation putting aside process, service, marketing, and organizational innovations as they are more difficult to measure with proxy indicators (e.g., Hipp, Grupp, 2005). From the various innovation typologies (see Fagerberg, 2005), innovation is distinguished from invention and defined here as 'conversion of knowledge into new products, services or processes (or the introduction of significant changes into existing ones) to be introduced on the market' (Molina-Morales, Mas-Verdu, 2008). There is a spectrum of variables used to describe innovation, including innovation counts, science publications, trademarks, etc., patents and R&D expenditure were used in this study.

R&D activity is one commonly used variable in regional innovation research. The limitation of the usage of R&D expenditure as a variable to describe innovation is that it is an input factor, which is really a measure of innovative input or effort, and not necessarily related to successful output (Gu, Tang, 2004; Coad, Rao, 2008). R&D statistics imperfectly capture the development of technology in small firms and certain industries, because R&D is only one out of several inputs, such as design, trial production, market analysis, training, etc. (Ratanawaraha, Polenske, 2007). Nonetheless, Thornhill (2006) and Tödtling et al. (2006) have shown that R&D positively correlates with innovation, and Hanel (2008) has noted that firms that conduct R&D are significantly more likely to innovate than those that do not. Furthermore, Sternberg and Arndt (2001) state that, the propensity to innovate is high for firms in regions with a high ratio of R&D expenditure to GDP.

Patents are also frequently used as an indicator of innovation. However, there are shortcomings in the usage of patents as an indicator of innovation. They measure the result of invention rather than innovation, not all firms make the effort to claim patents, certain sectors are poorly suitable for patent application, the range of patentable innovations constitutes only a sub-set of all research outcomes, not every registered patent is actually applied for and used, and the quality of individual patents varies widely – some inventions are extremely valuable, whereas others are of almost no commercial value (Gu, Tang, 2004; Ratanawaraha, Polenske, 2007; Coad, Rao, 2008). Although there is a systematic correlation between a firm's innovation output and its actual patenting behaviour, there are distinct differences in a firm's propensity to patent according to its size, sector, and cooperating partners (Brouwer, Kleinknecht, 1999; Kleinknecht et al., 2002). For example, Arundel and Kabla (1998) have calculated patent propensity rates (the percentage of patentable innovations that are actually patented) and shown that only a few sectors have patent propensity rates that exceed 50%. This is because firms can use secrecy or lead-time to protect their investment in innovation. In fact, Arundel (2001) has shown that R&D-performing firms do find secrecy a more effective means of appropriation than patents. Nonetheless, studies have shown that patents are an indicator of innovation (Sternberg, Arndt, 2001; Acs et al., 2002; Hagedoorn, Cloodt, 2003).

A further difficulty in the usage of the above-mentioned variables in measuring the innovativeness of regions is that, in the case of multiplant firms, R&D activities may be attributed to headquarters and not to the place where the R&D activities are actually conducted. The same holds true for patents, since patents are often the result of innovative activities conducted in regions which do not always coincide with those where the actual applying institution is resident (Evangelista et al., 2001; Kleinknecht et al., 2002). These facts may, thus, lead to an underestimation of the real innovativeness of some regions and overestimation of others.

The variables used to measure innovation are interconnected. Although some exceptions have been reported (e.g., Kleinknecht et al., 2002), several studies have shown that the variables described above correlate with each other and there is a strong and positive relationship between local R&D efforts and patents (Ahuja, Katila, 2001; Co, 2002; Bilbao-Osorio, Rodríguez-Pose, 2004; Cabrer-Borrás, Serrano-Domingo, 2007). These interconnections could mean that both of the indicators discussed here in greater detail could be viable measures of innovation. In fact, Hagedoorn and Cloodt (2003) as well as Gössling and Rutten (2007) have stated that statistically it does not make much difference which indicators of innovation are used. Thus, one could state that there does not seem to be a generally accepted indicator for innovation which could be claimed to be superior, and that the indicators that represent innovation have to be selected according to the objectives of each analysis. Additionally, data availability plays a role in the selection of indicators (see Kleinknecht et al., 2002).

THE RELATIONSHIP BETWEEN VARIABLES DESCRIBING INNOVATION AND VARIABLES DESCRIBING SOCIO-ECONOMIC DEVELOPMENT

As mentioned above, innovation is one variable considered highly influential to productivity and economic and regional growth, and it is an important, if not the key factor, for regional socio-economic development; it is ultimately a driver in the improvement in living standards. In fact, Mitchell (1999) argues that the single most important factor in creating growth in many economies is the advances made in technology, and Porter (2003) stresses that regional economic performance is strongly affected by the vitality and plurality of innovations. The key effect of innovations is that they increase productivity and productivity growth accounts, to a great extent for the growth in GDP (Rodríguez-Pose, 1999). Thus, innovations create wealth. However, wealth is also a precondition for innovation because wealth gives access to input factors for innovation (Gössling, Rutten, 2007). For example, it has been shown, that in general, national R&D intensity tends to increase along with per capita income (Mitchell, 1999).

The other variables describing regional development selected for the purpose of this study have several theoretical and empirical linkages to innovation so there should consequently be real correlations between them. The relationship between innovation and productivity, GDP, and GDP growth has already been stated. Furthermore, the presence of an (young) educated (the terms 'talented', 'creative', and 'skilled' are also commonly used) workforce and lower unemployment strongly influences the innovations made in a region (Rodríguez-Pose, 1999; Ceh, 2001; Sternberg, Arndt, 2001; Bilbao-Osorio, Rodríguez-Pose, 2004; Florida, 2005; Ewers, 2007; Gössling, Rutten, 2007; Czarnitzki, Hottenrott, 2009), and innovations have a positive and significant effect on employment (Van Reenen, 1997). At the same time the innovativeness of a particular region attracts educated human capital to that region (Faggian, McCann, 2009). Barkley et al. (2006) have shown that innovative activity is positively associated with population growth, employment, earnings, and, to some degree, with new housing. Urbanization has a positive influence on innovativeness and, furthermore, urbanization attracts better educated employees to a region (Florida, 2005; Bettencourt et al., 2007). Highly qualified professional employees are attracted to economic opportunities and quality of life factors (Simmie et al., 2002; De Noronha Vaz et al., 2006), which are, in general, better in cities. Thus, larger cities are more inventive per inhabitant than smaller ones (Bettencourt et al., 2007). Firms in urban agglomerations dedicate a greater share of their R&D to product development and have a higher likelihood of announcing new products compared to firms in rural regions (Brouwer et al., 1999). There is also a tendency for firms, and especially their R&D labs, to be located in the larger cities, which increases the innovativeness of metropolitan areas (Bettencourt et al., 2007). Housing and housing costs can also play an important role in innovation, they encourage workers to migrate to and stay in a region (Sternberg, Arndt, 2001; Ewers, 2007).

These above-mentioned theoretical and empirical linkages between variables describing innovation and variables describing regional socio-economic development are tested in this paper in a comprehensive way by using a single dataset and convergent methods, which sets this paper apart from previous studies that have used a whole spectrum of datasets and methods. Thus, the conclusions from previous literature can be tested and verified or disproved in a systematic way.

DATA AND METHODS

The data used here covers all of the (68) local administrative units (LAU-1) of mainland Finland and Åland as a whole (Fig. 1). LAU-1s (*seutukunta* in Finnish) are groups of municipalities that together form larger functional areas of daily

migration. The selection of LAU-1s as the observation units is a compromise between individual municipalities and the significantly larger NUTS-3 regions motivated by the general trend that Finnish municipalities have relatively low population counts, consequently suffering from low data availability. Furthermore, many municipalities act as suburban areas closely linked to the central town in the region, i.e., LAU-1. Indeed the selection of NUTS-3 regions would have significantly decreased the number of observations.

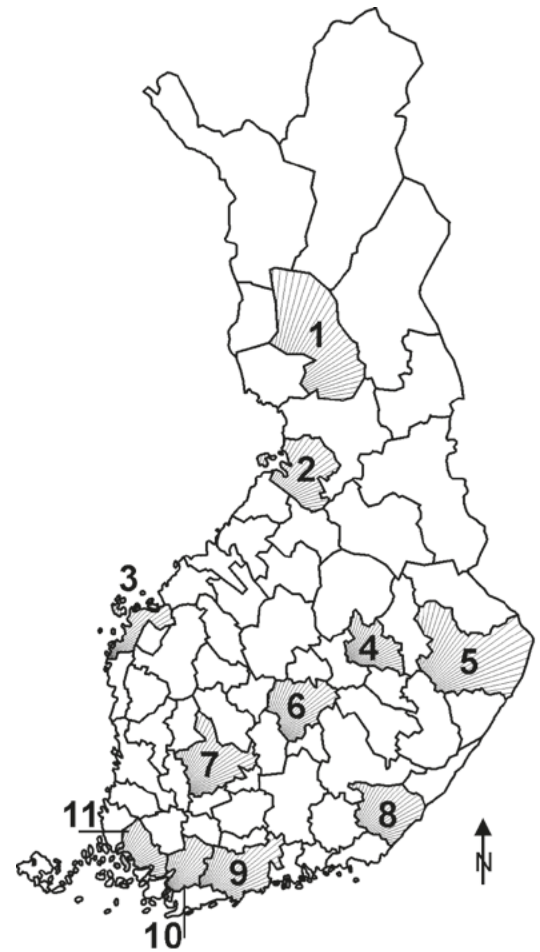

Fig. 1. Finnish LAU-1 regions in 2010 (university regions and Salo are highlighted)
Explanation: 1 – Rovaniemi; 2 – Oulu; 3 – Vaasa; 4 – Kuopio; 5 – Joensuu; 6 – Jyväskylä; 7 – Tampere; 8 – Lappeenranta; 9 – Helsinki; 10 – Salo; 11 – Turku

Source: Own elaboration based on a cartogram provided by Arttu Paarlahti, University of Helsinki

Table 1. Chosen variables for depicting innovation and regional socio-economic development

R&D expenditure	R&D expenditure/inhabitant
Patents	Patents granted/1,000 inhabitants
Population	Number of inhabitants
Population change	Net population change % (natural population change and migration)
Working population	Percentage of people of working age (between 15 and 64 years of age)
Unemployment	Unemployment rate %
Dependency ratio	Nonworking population compared with working population
Gender structure	Number of women compared with 1,000 men
Education	Percentage of population with higher education (20 years and older)
Urbanization	Percentage of densely populated areas
GDP	Gross domestic product/inhabitant
GVA	Gross value added/inhabitant
Income	Gross income/inhabitant
Housing	Percentage of small and/or inadequate housing
Housing costs	Average cost of housing €/m²

Source: Own compilation

The data was compiled or calculated from the official Statistics Finland databases (Altika and StatFin) and the Official Statistics of Finland (Table 1). Housing costs were compiled from the data of housing trade in the municipalities belonging to the LAU-1s. The variables describing innovation, GDP, and gross value added (GVA) have been compiled from earlier data with older LAU-1 divisions, which means that a few smaller contemporary municipalities are misplaced compared to the LAU-1 divisions used in this study. The data concerning regional socio-economic development was gathered from the year 2006 and the data concerning innovation from 2003–2005, because it is arguable whether innovation has an immediate impact on regional socio-economic development: instead a requisite time lag is needed. The missing data in some of the variables is calculated by using proportional averages, based on the population of the neighbouring LAU-1s and the number of inhabitants in the LAU-1 in question.

In this study, correlation analysis is used to explore connections between the variables that describe innovation and the variables describing regional socio-economic development. As is often the case when analyzing regional statistics, most of the variables examined here do not follow a normal distribution (tested with Shapiro-Wilk test of normality). Thus, the dataset is analyzed with Spearman's correlations because, as a non-parametric method, it is not based on the presumption that variables follow a normal distribution. A description of different correlation indexes can be found, e.g., in Chen and Popovich (2002). When using correlation analysis it is important to bear in mind that, as such, correlation does not reveal anything about the causality between variables. Correlation simply states whether there is a connection between the variables and the intensity and direction of this connection, but, fortunately, it also provides information regarding what the plausible causal relationships might be.

RESULTS AND DISCUSSION

Almost all of the correlations between the innovation indicators and the variables describing regional socio-economic development are statistically highly significant (Table 2). Only unemployment seems to be uncorrelated with R&D

Table 2. Spearman's correlation matrix for indicators of innovation

2006		Patents 2003	Patents 2004	Patents 2005	R&D 2003	R&D 2004	R&D 2005
Population	Cor.	0.352**	0.370**	0.200	0.653**	0.653**	0.673**
	Sig.	0.003	0.002	0.099	< 0.001	< 0.001	< 0.001
Population change	Cor.	0.468**	0.505**	0.326**	0.621**	0.609**	0.580**
	Sig.	< 0.001	< 0.001	0.006	< 0.001	< 0.001	< 0.001
Working population	Cor.	0.429**	0.425**	0.160	0.662**	0.643**	0.631**
	Sig.	< 0.001	< 0.001	0.189	< 0.001	< 0.001	< 0.001
Unemployment	Cor.	-0.233	-0.316**	0.298*	-0.077	-0.065	-0.048
	Sig.	0.054	0.008	0.013	0.528	0.598	0.694
Dependency ratio	Cor.	-0.561**	-0.591**	-0.482**	-0.568**	-0.550**	-0.524**
	Sig.	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Gender structure	Cor.	0.510**	0.399**	0.302*	0.584**	0.620**	0.646**
	Sig.	< 0.001	0.001	0.012	< 0.001	< 0.001	< 0.001
Education	Cor.	0.546**	0.445**	0.286*	0.738**	0.745**	0.733**
	Sig.	< 0.001	< 0.001	0.017	< 0.001	< 0.001	< 0.001
Urbanization	Cor.	0.592**	0.462**	0.339**	0.687**	0.695**	0.684**
	Sig.	< 0.001	< 0.001	0.004	< 0.001	< 0.001	< 0.001
GDP	Cor.	0.502**	0.422**	0.336**	0.609**	0.630**	0.624**
	Sig.	< 0.001	< 0.001	0.005	< 0.001	< 0.001	< 0.001
GVA	Cor.	0.514**	0.437**	0.347**	0.605**	0.630**	0.621**
	Sig.	< 0.001	< 0.001	0.003	< 0.001	< 0.001	< 0.001
Income	Cor.	0.617**	0.531**	0.389**	0.684**	0.682**	0.670**
	Sig.	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001
Housing	Cor.	-0.426**	-0.359**	-1.179	-0.573**	-0.567**	-0.557**
	Sig.	< 0.001	0.002	0.141	< 0.001	< 0.001	< 0.001
Housing costs	Cor.	0.382**	0.339**	0.175	0.615**	0.628**	0.614**
	Sig.	0.001	0.004	0.149	< 0.001	< 0.001	< 0.001

Explanation: ** Correlation is significant at the 0.01 level. * Correlation is significant at the 0.05 level

Source: Own calculations based on the data collected from Statistics Finland – at www.stat.fi expenditure. Patents per inhabitant from the year 2005 forms an exception to the discussion above. The correlation between them and the variables describing regional socio-economic development are relatively less significant. Although some of the weakening of the correlation coefficients can be explained through an overall drop in the number of patents in Finnish LAU-1s, it seems that patents need more time than R&D activity to have an impact on regional socio-economic development. The same trend, however, is also generally visible in the case of R&D expenditure.

The results support the theoretical framework of this study. The positive connection between innovation and economic and regional growth is clear in Finland. The indicators of innovation have a strong, positive, and significant correlation with GDP, GVA, and income. Thus, as Gössling and Rutten (2007) have shown, the connection between innovation and wealth could be bidirectional: innovation creates wealth and at the same time wealth is a precondition for innovation. Since population and innovation correlate highly and significantly with each other, a sufficient population base can contribute to the innovativeness of Finnish regions. The hypothesis of the heightened innovation tendency of cities compared to rural areas is supported by the fact that in Finland urbanization correlates highly and significantly with indicators of innovation. The results can be generalized at a level which states, as Bettencourt et al. (2007) have done, that larger cities (more urbanized) are more inventive per inhabitant than smaller ones. The positive association with innovation and population growth suggested by Barkley et al. (2006) is also supported by the Finnish data. When these results are viewed from another standpoint it could be stated equally well that innovations can generate city development and urbanization. In fact, innovations made in agriculture are conventionally seen as the starting point of the history of urbanization (Bairoch, 1988).

According to the Finnish data, education has a strong, positive, and significant correlation with indicators describing innovation. The same holds true for the working population. These findings verify earlier statements in literature (e.g., Ceh, 2001): the presence of an educated workforce is a very important factor affecting the rate of innovation. Two other clear indicators of regional socio-economic development, gender structure and dependency ratio, also correlate with indicators of innovation. An unbiased gender structure (when the ratio of women to men is balanced) has a positive correlation with indicators of innovation. The correlation between the dependency ratio and indicators of innovation is negative, which means that the smaller number of people outside the working population in comparison to the workforce, the higher the innovativeness of the region or vice versa. These findings strengthen the notion that innovation is connected with regional socio-economic development.

It also seems that in Finnish regions housing and housing costs do play a part in innovation as earlier studies (Sternberg, Arndt, 2001; Barkley et al., 2006; Ewers, 2007) have suggested. Indicators of innovation are negatively and significantly correlated with housing. Because the standard of housing is measured here as the percentage of small and/or inadequate housing, this means that good housing conditions and indicators of innovation are connected. This is further supported by the fact that higher housing costs and the indicators of innovation are in correlation with each other. Also, in this case the effects are probably reciprocal: the good housing conditions attract possible innovators to move into the area, and as innovations seem to create wealth they also heighten the demand and enable the construction of better and more expensive housing.

Earlier notions (e.g., Rodríguez-Pose, 1999; Barkley et al., 2006) about the connection between low unemployment and indicators of innovations and the positive effect innovations on employment growth are not supported by this analysis since there seems to be little connection between the indicators of innovation and the unemployment rate. One explanatory factor might be that technological innovation usually leads to a heightened efficiency, i.e., to a decrease in the need for manpower.

CONCLUSIONS AND LIMITATIONS

The results of this study support the earlier findings which demonstrate that the individual variables used to describe regional socio-economic development are connected with indicators of innovation. However, the analyses used in this paper were conducted using a single dataset and convergent methods. In contrast to previous research which utilizes divergent datasets and methods, this paper has provided more systematic and comprehensive evidence of the linkages between regional socio-economic development and innovation.

From the multitude of different correlations one conclusion is that innovation and regional socio-economic development are connected in Finland: almost all of the variables describing regional socio-economic development (apart from unemployment) used in many earlier studies on the regional development of Finland (e.g., gender structure, dependency ratio, and housing) are connected to the indicators of innovation education acting as a good example. The positive connection between innovation and regional economic development is, thus, clear (GDP, GVA, and income are positively and significantly correlated with indicators of innovation). The causal connection between regional socio-economic development and innovation is likely to be bidirectional. Innovations generate regional development and a certain stage of regional development is necessary to create innovations (see Gössling, Rutten, 2007). More developed regions have better conditions for creating innovations than regions that have lagged behind and it indeed seems that larger cities are more inventive than rural areas (indicators of innovations are positively and significantly correlated with population, urbanization, and population change). It could also be concluded that innovation is, in fact, part of regional socio-economic development and indicators of innovation should be used to describe the development stage of regions alongside more traditional socio-economic indicators. This paper also confirms the need to consider time lags between R&D, patent statistics and regional socio-economic development. This confirms the more general trend which suggests that there are time lags between the introduction of innovative activities and their impacts upon traditional socio-economic data.

It should be noted that this study does not make any generalizations about the connection between innovation and regional development on a larger scale. The data is collected from Finland and, thus, the results represent the situation in Finland. In other countries, the connections could be different or there could be no significant correlations at all. This might be an interesting viewpoint for future studies as it is nonetheless likely that the situation may be quite similar in at least other developed countries. It also has to be kept in mind that in this study only proxy indicators, and not direct innovation counts, are used to present the innovation phenomenon. In addition, a cause for some caution is the fact that the missing data is calculated by taking advantage of the neighbouring LAU-1s, thus decreasing the actual variation in the data. However, the analysis was also conducted by using the original dataset with the missing data, and the results were very similar to the ones represented here.

NOTES

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